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United States Department of Agriculture,

SECTION OF SEED AND PLANT INTRODUCTION.

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THE BEST HORSE-RADISH VARIETIES OF EUROPE, AND METHODS OF CULTIVATION.¹

Horse-radish is a plant which, according to common opinion, requires no cultivation. Once planted in the back yard, it is expected to furnish a supply of fresh roots whenever these are needed. This is the American idea. In Europe, however, the value and cultivation of horse-radish are differently viewed. There the hotel keepers know that the best horse-radish comes from Bohemia and Bavaria, and most of them are acquainted with the names of the different varieties, for, though it may seem strange to Americans, there are many varieties of horse-radish.

The cultivation of horse-radish will pay. An enterprising truck farmer near Philadelphia states that last year he cleared over \$300 per acre on a patch of horse-radish to which he paid special attention. He sold his best marketable roots at a profit of \$7 to \$12 per barrel. Yet this grower knew nothing of the improved European varieties and methods of culture, and manifested great interest in an account of them.²

The object in publishing this circular is to awaken a more intelligent interest in this minor crop among American farmers and gardeners. The methods employed in Europe and described herein will, it is believed, prove instructive, and may serve as a basis for a beginning

¹ Attention is called to a recent importation by the Department of Agriculture of a selection of roots of both the Maliner and Bayersdorf varieties of horse-radish, secured by Mr. Fairchild. These have been distributed to some of the agricultural experiment stations for testing.

² Ignorance in regard to the best methods of horse-radish culture is not confined to America. Within 60 miles of Malin, the little town in Bohemia where the most famous horse-radish is grown, the writer sought from a teacher of horticulture a description of the best methods of culture. But the methods, as he described them, and as afterwards published in Circular No. 20, Division of Botany, turned out to be very different from and inferior to the methods in use at Malin. Another teacher of agriculture, not over 100 miles away, published an account for distribution in Austria which does not at all represent the methods of cultivation.

of its systematic culture in America, after which the necessary modifications to suit American conditions will naturally follow.

In an examination of the vegetable market in Nuremberg, Bavaria, my attention was attracted by a characteristic type of horse-radish. On inquiry I discovered that it was grown within an hour's ride by rail of Nuremberg and that the picturesque, prosperous village of Bayersdorf, of about 1,300 inhabitants, was supported almost exclusively on the profit of horse-radish growing. A visit to this quaint village and some hours' conversation with the principal horse-radish grower, Mr. Karl Schoene, brought out a number of interesting facts.

BAYERSDORF HORSE-RADISH.

The Bayersdorf horse-radish (sometimes called "Nuremberg" in Austria) is a very mild-flavored variety, so mild, in fact, that United States Consul Weber, of Nuremberg, complained of its insipid flavor. The roots as they are sold on the markets are large, with round, regular crowns, and are covered with warty or knotty excrescences. The flesh is white and clear, but slightly woody on account of the method of cultivation. On hotel tables this variety is most often served in thin shavings, as is customary generally in England and Sweden. Owing to the very mild character of the spicy oil contained, considerable quantities can be eaten without discomfort. Most people, however, prefer a sharper, more pungent variety. Owing to the cheapness with which this sort is grown in Bayersdorf and its systematic advertisement, it is exported in large quantities to northern Germany, Austria, Russia, Italy, and even to France and England. One small shipment was made last year to America. About 2,000,000 roots were shipped from Bayersdorf last season, half of this amount having been supplied by one grower.

The Bayersdorf culture is an old one from an American standpoint, having been carried on over fifty years, but a veritable mushroom compared with many Bavarian cultures. Owing to the cheaper methods of cultivation, and some attention paid to advertisement, the Bayersdorf horse-radish culture is a growing industry and threatens to crowd out the superior and more expensive Austrian industry, that of the so-called *Maliner Kren*.

The methods of cultivation employed in Bayersdorf are simple. The soil is a rich sandy loam, which is well drained, thoroughly worked over to a depth of 15 or 16 inches, and well fertilized with cow manure. The planting is usually done in May. The root cuttings are 10 to 12 inches long. They are taken from the long, slender roots cut off and left in the ground when the previous crop was harvested. Each cutting is laid in the earth at an angle of about 30 degrees with the surface of the soil. Its upper end is buried not over 4 to 6 inches deep. The cuttings are placed 14 inches apart each way. The ground is

carefully cultivated until the latter part of June, at which time the field is gone over and the roots are "rubbed." The rubbing process consists in removing the soil from the upper part of the obliquely laid cutting, and with the fingers rubbing off all of the small roots which have formed. The cutting is replaced in the earth and carefully buried as before. The rubbing process is repeated in the latter part of July, cultivation and the removal of weeds are rigorously attended to, and in September the marketable roots are harvested. These are unearthed and cut loose from the several slender roots which have formed at their lower ends. These long, slender roots are left in the ground over winter, and are dug in the spring and used as cuttings for the new planting. From 7,500 to 10,000 marketable roots are harvested from an acre, and they fetch at Bayersdorf, delivered in large hogsheads holding 1,500 roots, \$3.57 per hundred for the best,



FIG. 1.—Varieties of European horse-radish: (1) Bohemian or "Maliner Kren," length 14 inches; (2) Bavarian or Bayersdorf, length 16 inches; (3) South German, Dresden, or Magdeburg, length 18 inches—all purchased on the market in Saaz, Bohemia. Fig. 1 does not do justice to the Malin variety. The shoots are often more than twice as thick.

and \$1.42 to \$1.90 for second grade, i. e., smaller roots. According to these figures the gross receipts from an acre of horse-radish would average in Bayersdorf from \$230 to \$300, which should, considering the low prices of labor in that region (not over 75 cents per day at most), net a handsome profit.

It will be seen from the above that the marketed roots of this Bayersdorf variety are in fact two seasons old. They have spent the first year as slender roots, formed from the lower ends of cuttings, and the second year as planted root cuttings. The more woody or fibrous texture of the flesh of the Bayersdorf horse-radish as compared with

that of the Maliner Kren is due to its being 2 years old, while the latter is of only one season's growth.

During a visit to the "Year Market," in the quaint hop-producing town of Saaz, Bohemia, my attention was attracted to three quite distinct types of horse-radish roots, and after much discussion with the market women, each of whom declared her wares to be the true "Maliner Kren," I succeeded in finding a dealer who revealed the origin of the three sorts. The accompanying photographic reproduction (fig. 1) is of the three varieties purchased on the Saaz market.

It will be evident at a glance that (1) belongs to quite a different category from (2) and (3), which have much in common. The shorter length, smoother skin, and absence of small roots at its tip indicate to a practiced eye a different method of culture at least, if not a varietal difference. This (1) is the true Maliner or Bohemian horse-radish, (2) is the Bayersdorf variety, and (3) a large, coarse, yellowish-skinned sort grown somewhere about Dresden or Magdeburg, according to the information given by the Saaz dealer.

A day spent with the largest grower in the Malin' region, Mr. Paul Zednik, put me in possession of the facts regarding the culture of the Maliner horse-radish, and a connected description of the culture was kindly given me by Mr. Cievárek, director of the Agricultural School of Kuttenberg.

MALINER KREN, OR BOHEMIAN HORSE-RADISH.

"*Kren*" is the Germanized form of the Bohemian Czechisch word *Křen*, meaning horse-radish. It is interesting to note that, like the

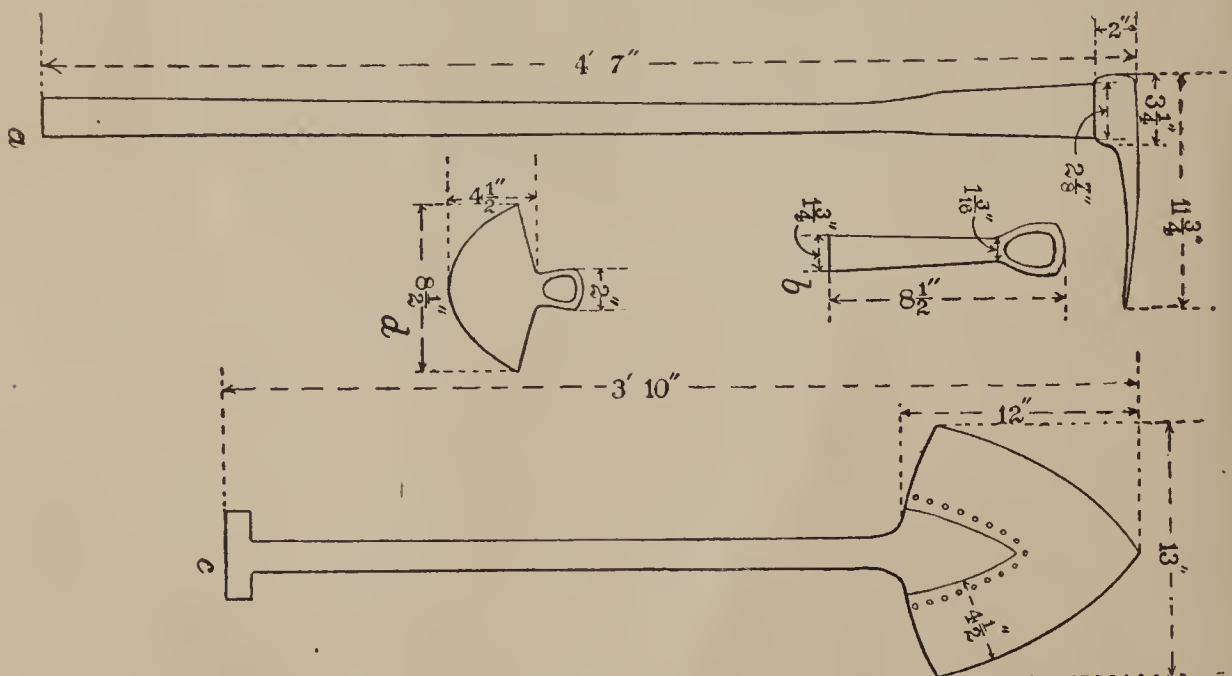


FIG. 2.—Implements used in horse-radish culture: (a) Horse-radish mattock, side view, for digging holes and harvesting crop—an essential tool; (b) Same, top view, showing broadened tip of blade; (c) Steel-shod wooden spade, inferior to American spade, though very light and effective, used in working over the soil; (d) Primitive hoe used in weeding, vastly inferior to American hoes.

culture of the hop and the sugar beet, the cultivation of the horse-radish in Bohemia is very old.

Only a deep soil rich in humus is suitable for the culture of horse-radish according to the Malin method. A soil that has been previously loosened by the long fibrous roots of a crop of clover or alfalfa is preferred, as it is mellow to a considerable depth and rich in nitrogen.

In autumn the ground is worked to a depth of 18 inches by means of an iron-shod wooden spade (see fig. 2, *c*), or, if necessary, with a deeply set plow. The following May the soil is again worked, and by means of a long, narrow-bladed mattock (fig. 2, *a*) especially designed for the purpose, holes are dug in the ground 2 feet apart each way. These holes are about 14 inches deep, 8 inches long at the bottom, 15 inches long at the top, and a little wider than the mattock blade, or less than $2\frac{1}{2}$ inches. A short cutting, not over 6 to 7 inches long, from a medium-grade shoot of the previous harvest, is dropped into this narrow hole. This cutting, which must have two buds, is pressed almost horizontally into the ground with the mattock.

The small end of the cutting is pressed half an inch lower into the ground than the other end. The hole is now filled with the well-worked top soil. Planting, although commonly done in the spring, is sometimes done in the autumn.

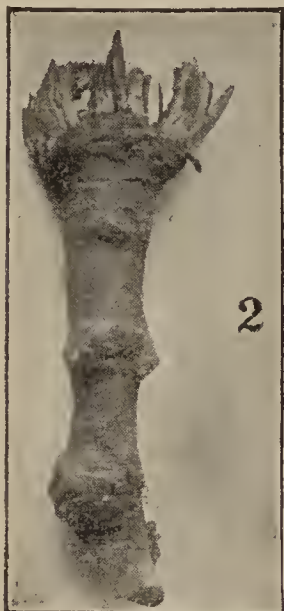
A few weeks after planting the cuttings send up shoots. As soon as these appear the ground is carefully worked with a hoe (see fig. 2, *d*). Should a cutting send up several shoots, which is generally the case, the weaker ones are trimmed out by hand, and only one shoot per cutting is allowed

to remain. In this thinning process, which is done after a rain has softened the soil, the workman carefully removes the dirt from about the shoots, selects the ones to be pulled out, and with a sharp twist breaks off separately each of the weaker sprouts. Considerable care is necessary in this operation, as the original buried cutting, which is now called the "*mother root*," may be injured or displaced by a careless pull on the shoots to be removed. When good cuttings are planted they produce, even the first season, a surprisingly large marketable shoot, provided the thinning out is carefully attended to.



FIG. 3.—Old mother root of Malin horse-radish: (1) The decayed remains of the original cutting, which was set out seven or eight years ago; (2) Root grown from mother root or original cutting. This was several feet long; only a small part shown; (3) Lower end of a marketable shoot, showing how the marketable part was cut too short by the digger.

The harvesting is done in Bohemia in October or November. This requires the skillful employment of the special long-bladed mattock above mentioned (see fig. 2, *a*). The leaves are first cut off and the digger strikes with his mattock once on either side of the shoot to lay the crown bare, and then with a heavy stroke behind severs deep down in the ground the marketable shoot from the mother root, the latter remaining in the soil. If the workman is unskillful, he may cut into the mother root and injure it, or not strike deep enough and get a shorter shoot than necessary.



This method of culture is radically different from that practiced in Bayersdorf, inasmuch as the original cutting is not removed from the ground, but a fresh shoot is cut from it. This original cutting, or mother root, remains many years where it was first planted, sends down long, deep roots, and produces every year a marketable shoot. After ten to fifteen years the rotted remains of this cutting are still to be found. In the illustration on page 5 (fig. 3) the decayed mother root is indicated by



(1), the root growing from it by (2), and the lower end of a marketable shoot which was cut too short by (3). In fig. 4 are shown the relative size of mother root and shoot and their relative position in the soil.

In exceptional cases an old mother root is strong enough to produce two good shoots, but in general only one is permitted to grow. The method of culture for the second and succeeding years after the laying out of a horse-radish patch is simple, but, as carried on at Malin, it requires much hand

FIG. 4.—Malin horse-radish, showing relative position of mother root and marketable shoot in ground: (1) Remains of original cutting, 7 or 8 years old, with roots attached; (2) Marketable shoot, showing how it is produced by the mother root. (As the shoots were all dug at time of my visit I was unable to get a specimen of mother root and shoot attached.)

labor. The field is worked over with a pointed spade to a depth of not more than 10 to 12 inches. Great care is taken not to strike deep enough to injure the mother roots, which lie at a depth of about 14 inches. It is of the first importance to have this layer of earth above the mother root in the mellowest possible condition, to enable the large, vigorous shoots to push their way out through the soil. The thinning-out operation for later years is the same as for the first year,

except that less care is necessary, as the old mother roots are not so easily injured.

The marketable produce, after digging, is separated into three grades: *Prima*, which is sold at $5\frac{1}{2}$ to $7\frac{1}{4}$ cents per pound; *secunda*, which is sold at 4 to $5\frac{1}{4}$ cents per pound; and *terzia*, which is sold at $2\frac{1}{2}$ to $3\frac{1}{2}$ cents per pound. I was unable to secure statistics as to the actual quantity exported, but learned that the culture is dying out. The inferior Bavarian product, because it has free entry into Austria and can be produced more cheaply, and perhaps because the producers are more energetic in advertising and pushing it, is gradually driving the Bohemian product out of the market. In 1880 there were in the neighborhood of Malin about 100 acres of kren. In 1891 this acreage had fallen to about 85 acres. The acreage is now even less. In the neighboring regions of Kuttentberg and Heizov, where the Maliner horse-radish is also grown, the decrease in acreage is said to be greater.

I am told that an attempt will be made this year in the Austrian parliament to have an import duty of \$4 per 220 pounds placed on foreign horse-radish. This, it is believed, will enable the producers not only to continue but to profitably extend the cultivation, and ultimately to compete with the cheaper Bavarian product. Whether or not it will finally enable them to improve and cheapen their methods of production and distribution, so that the Maliner kren will become an important article of export, is doubtful. The hand labor connected with its production will make it a more expensive vegetable. I do not feel convinced, however, that this hand labor is really necessary. With our modern American plows and deep cultivators a large saving of labor can certainly be made.

A good deal has been written about the peculiarities of the soil about Malin, and it is claimed that the fine aroma characteristic of the horse-radish grown there is a result of these soil conditions. This may be quite true, and the growers at Bayersdorf and elsewhere, who claim that the cuttings from Malin, when planted in other soil produce no better product than their own sorts, may be right, but as yet I have been unable to learn of any attempts being made in which the methods of Malin were transplanted as well as the cuttings.

In any case, the trial by American truck growers is well worth making, and the profits in a small way are reasonably assured. Prof. Emanuel Gross, of the Agricultural School of Tetschen-Liebwerd, gives, in a small brochure,¹ a statement of the expenses of the culture and probable profits, and urges gardeners to take up its cultivation. His figures have only a secondary interest to American growers, as the labor conditions are entirely different.

¹ *Über die Cultur des Krens*, Wien, 1897.

I.—*Cost of setting the garden per hectare (2.47 acres).*

Deep plowing	\$4. 82
Cultivation	3. 37
Weeding.....	7. 23
Cultivating and marking for cuttings	6. 75
Manuring and spreading of manure:	
Thirty wagonloads of stable manure	28. 92
Spreading of same	2. 40
Digging of holes for cuttings.....	5. 78
Composted manure for the holes when cuttings are set (five wagon-loads) ..	7. 23
Placing of cuttings and dropping of manure in holes	5. 78
Cost of cuttings (set 24 inches apart each way)	301. 25
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	373. 53
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II.—*Yearly expenses of maintenance per hectare.*

Interest on capital, at 5 per cent.....	20. 65
Two cultivations, including rubbing process.....	28. 92
Cost of harvesting crop.....	24. 10
Manure and compost, and cost of spreading the same:	
Fifteen wagonloads of stable manure.....	14. 46
Spreading and transport to field of same	19. 28
Miscellaneous expenses	28. 92
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	136. 33
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III.—*Receipts.*

Average crop, 6,600 pounds, at \$6.57 per cwt.....	433. 60
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The gross cost for the first two years, including interest on the value of the land, would be about \$536.51. Although during the first year the cost is \$373 the yield is already \$289.20, so that the net profit per hectare (2.47 acres) amounts to \$186.50 at the end of the second year, while the following years the cost of maintenance sinks to \$136.33, or lower, and the receipts remain the same.

The evident superiority of the Maliner horse-radish will certainly enable the grower to demand a higher price for it. Gardeners should no longer neglect the culture of one of the best of all appetizers.

DAVID G. FAIRCHILD,
Agricultural Explorer.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *December 24, 1900.*